Groundwater Monitoring Activities Update

KASMC Executive Meeting, Lexington, Kentucky, December, 2014

Chuck Taylor, Glynn Beck, Bart Davidson, and Jim Currens, Water Resources Section,
Kentucky Geological Survey,
University of Kentucky

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Groundwater Monitoring Issues Addressed in 2014 Draft KASMC Work Plan

Kentucky Agriculture Science and Monitoring Committee (KASMC) – 3-year cooperative scope of work and work plan (2015-2017)

- Acknowledges technical and resource-limitation issues involved in monitoring Kentucky's groundwater.
- Focused on need for improved monitoring of groundwater conditions in major aquifers in where use of high-yield irrigation and public water-supply wells is increasing.
- Improved Aquifer Boundaries and Water-Table or Potentiometric Surface Mapping.
- Acquisition of Additional Groundwater Quality Data.
- Improved Reporting and Internet Access to Groundwater Quality Data.
- Special Studies to Better Characterize Groundwater Hydrology; Esp. Factors that Influence Groundwater Quality and Quantity.

Current Things KGS Is Doing to Address:

- Improved monitoring of groundwater conditions in major aquifers in where use of high-yield irrigation and public water-supply wells is increasing.

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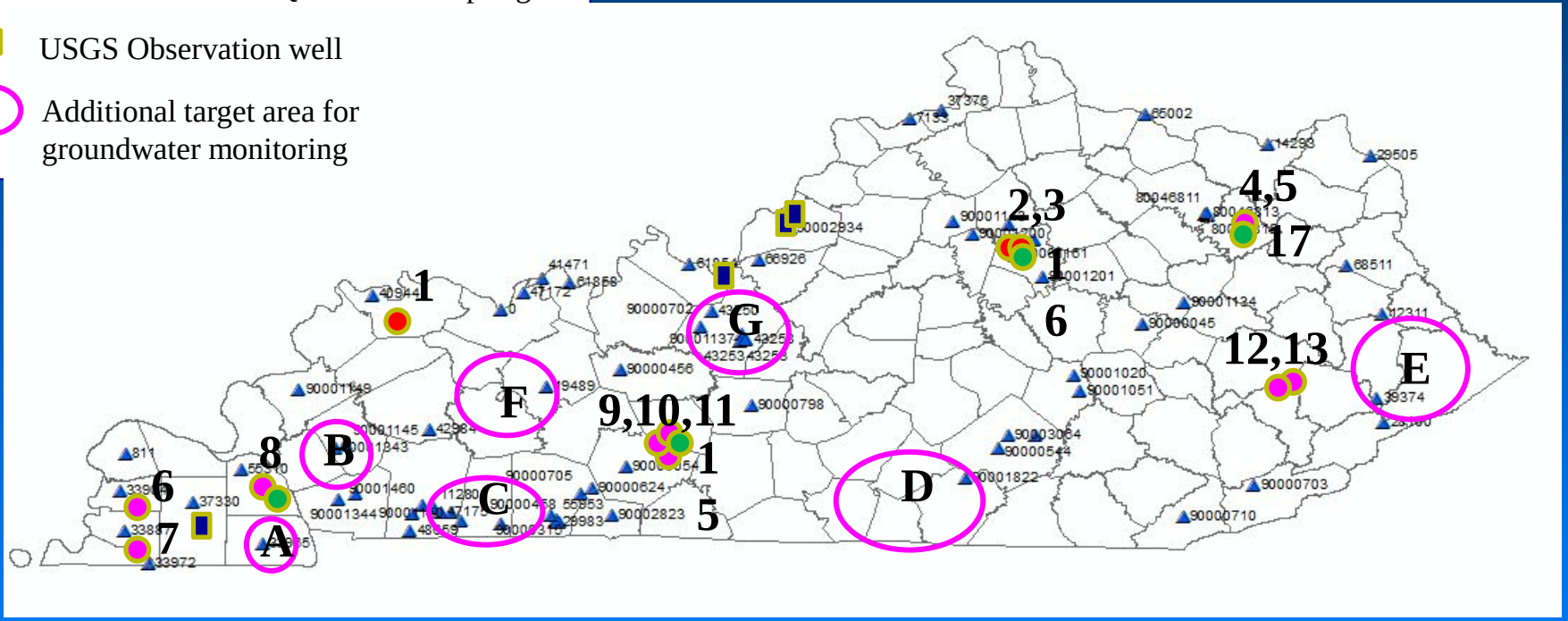
Re-establishment of Statewide GW Observation Network (KGON)

- Existing KGS GWL observation well
- Proposed KGS GWL observation well
- Proposed "Livestream" spring
- KDOW-ITAC GWQ network sampling site
- USGS Observation well
- Additional target area for groundwater monitoring



Plans call for GWL monitoring at 10-12 selected well sites (incl. shallow-deep or well-spring clusters in some complex aquifers) and GWQ-discharge monitoring at 4 spring sites by mid-late 2015.

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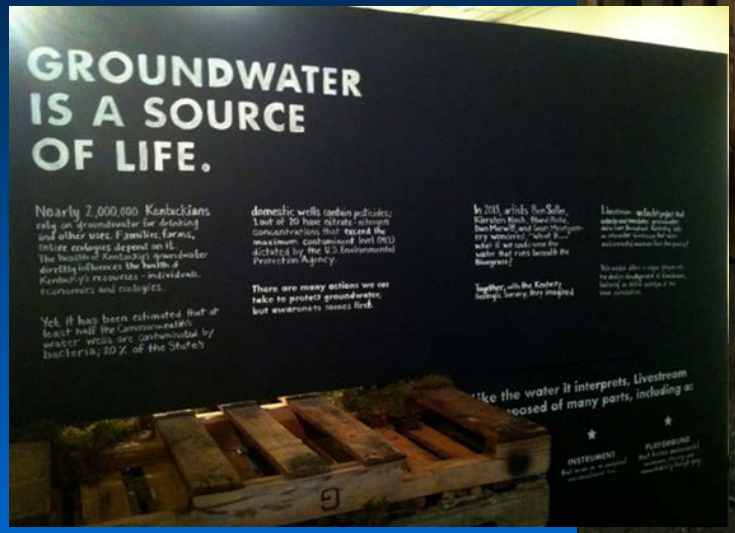
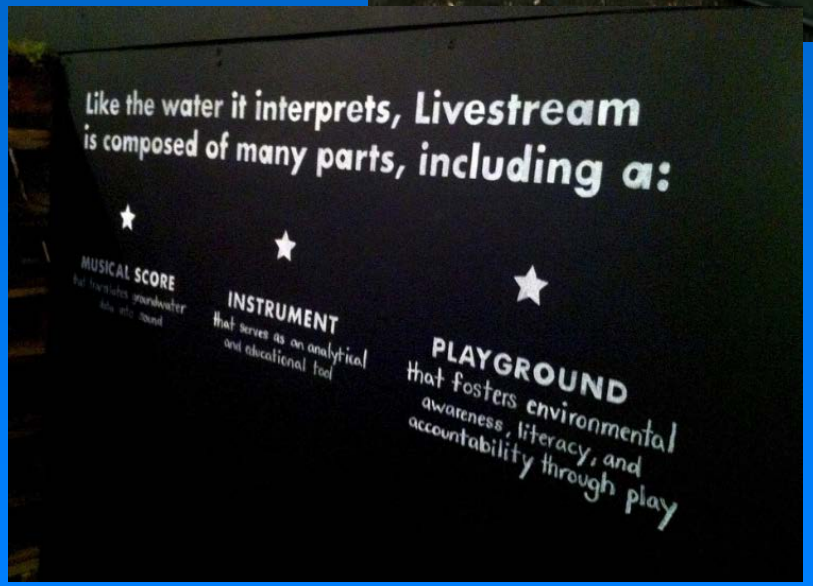
“Livestream” Groundwater Spring Monitoring

- NEA-funded EcoArts Project.
- Collaboration between Public Works LLC (New York), LFUCG Dept. Environmental Quality, and Parks and Recreation, and KGS.
- $72K in funds being raised for real-time discharge/WQ monitoring at four regionally representative spring sites.





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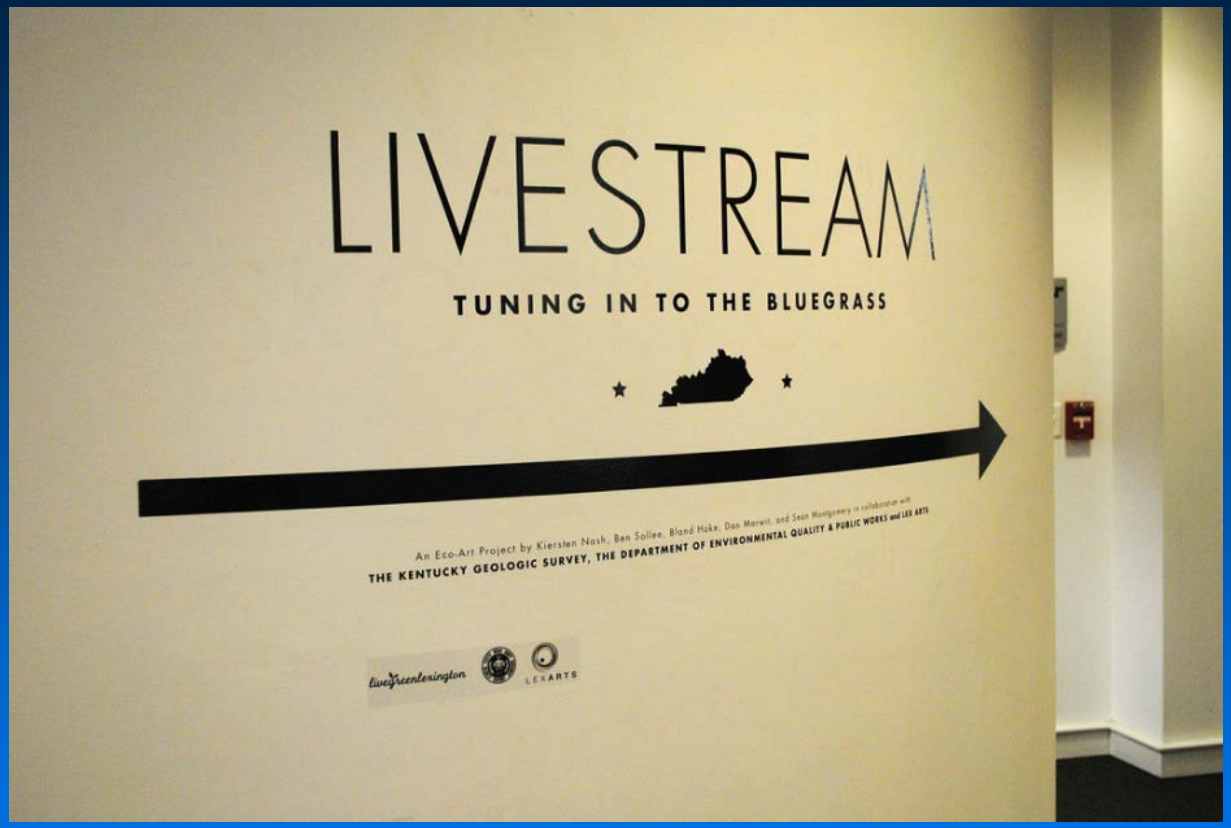
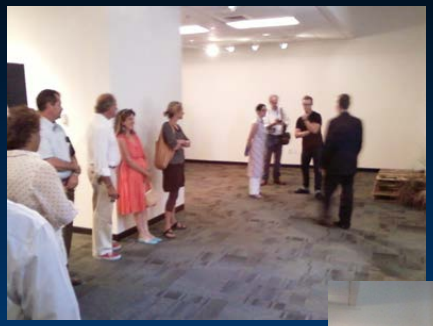
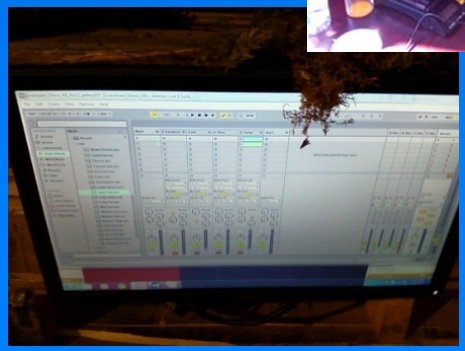
Livestream Concept Launch at Downtown Arts Center, July 9, 2014







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Current Things KGS Is Doing to Address:

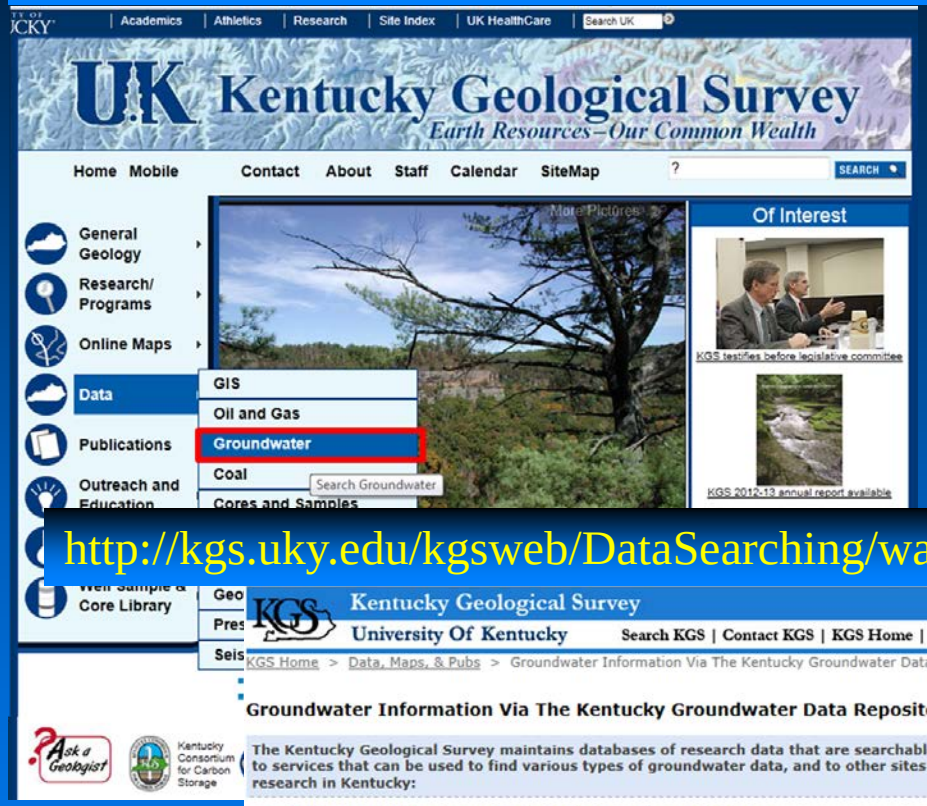
- Acquisition of Additional Groundwater Quality Data.
- Improved Reporting and Internet Access to Groundwater Quality Data.

Groundwater Data Collected In Kentucky Are Stored and Accessed Through Groundwater Data Repository (GWDR)

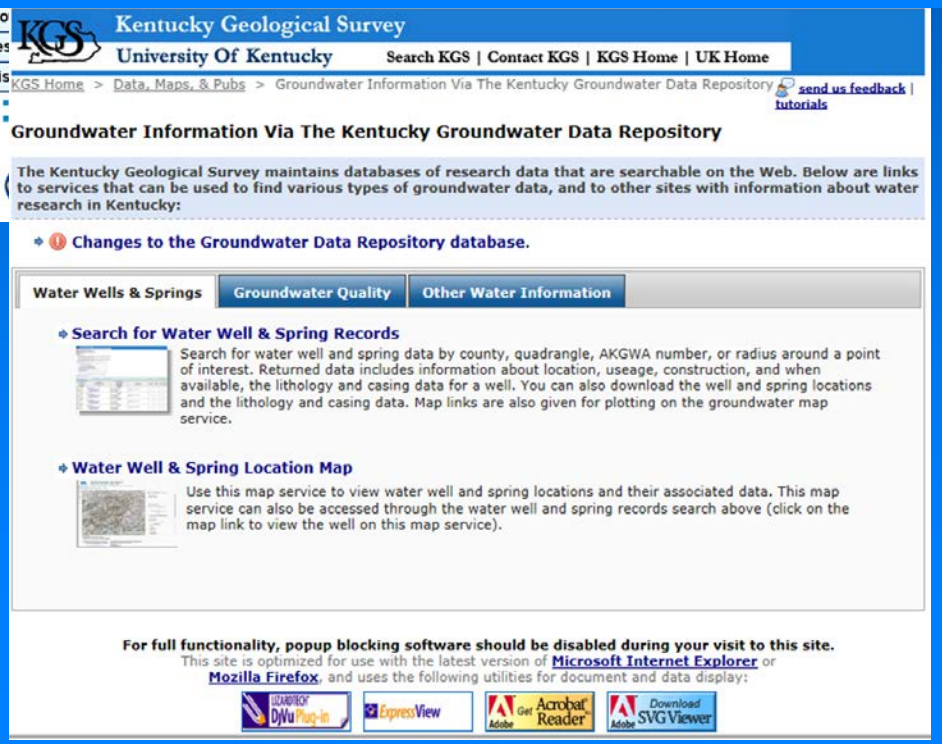
- 1990 legislative mandate (KRS 151:035) maintained by KGS.
- Currently:
  - Over 92,000 water well records.
  - Approximately 5,100 spring records.
  - About 60,000 groundwater-quality analyses.
- Over 15 contributing agencies, including KDOW and USGS.
- New:

  Scanned drillers logs (well construction) obtained from KDOW Certified Well Drillers Program.

http://www.uky.edu/KGS/



http://kgs.uky.edu/kgsweb/DataSearching/watersearch.asp



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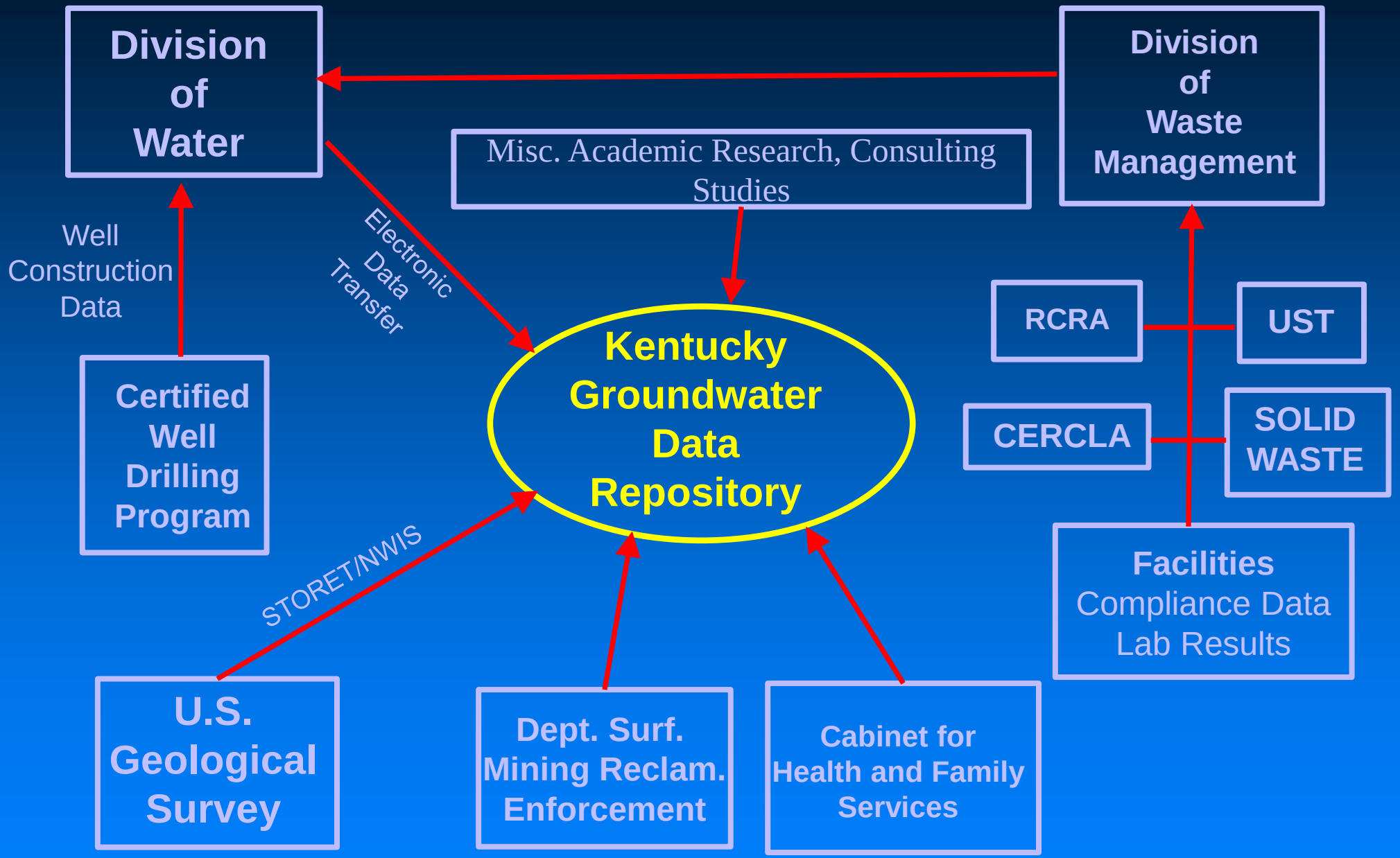
Interagency Data Collection and Transmission to KGS for GWDR:



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http://www.uky.edu/KGS/water/gnet/

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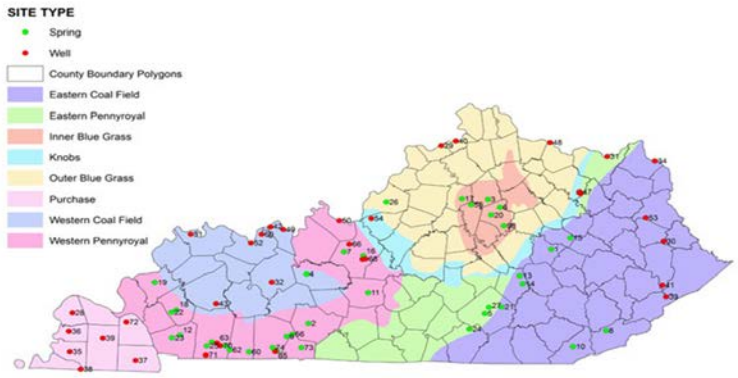
Kentucky Interagency Groundwater Monitoring Network

Contact: Bart Davidson

Groundwater is essential to the economy of Kentucky and to the health of its citizens. Despite its extensive use, until recently there was little systematic effort to describe groundwater quality and to make that information widely available. Recognizing the importance of groundwater, the 1998 Kentucky General Assembly directed the Kentucky Geological Survey to establish a long-term, interagency groundwater monitoring network to characterize the quality, quantity, and distribution of groundwater in Kentucky (Kentucky Revised Statute 151.625). The major goals of the Interagency Groundwater Monitoring Network are to (1) collect groundwater data, (2) characterize groundwater quality, (3) distribute groundwater information, (4) improve coordination between agencies that collect groundwater data, and (5) facilitate sharing of groundwater data (Interagency Technical Advisory Committee, 1996). The network is assisted by an Interagency Technical Advisory Committee on Groundwater (ITAC), which is composed of State, Federal, and university representatives. The ITAC was established by KRS 151.629.



Kentucky Interagency Groundwater Monitoring Network sampling sites maintained by the Kentucky Division of Water.

Map No.	AKGWA	Sample Frequency	Map No.	AKGWA	Sample Frequency	Map No.	AKGWA	Sample Frequency
1	90000045	Q	26	90002934	Q	51	00040944	Q
2	90000054	Q	27	90003064	5Q	52	00065149	Q
3	90000055	M	28	00000811	5Q	53	00068511	Q
4	90000456	5Q	29	00007133	5Q	54	00066926	Q
5	90000544	5Q	30	00012311	Q	55	90001200	Pest. MOA
6	90000552	Q	31	00014293	2Q	56	90000624	Pest. MOA
7	90000702	Q	32	00019489	5Q	57	90001150	Pest. MOA
8	90000703	Q	33	00028100	5Q	58	90001201	Pest. MOA
9	90000705	M	34	00029505	2Q	59	90001460	Pest. MOA
10	90000710	5Q	35	00033887	5Q	60	90001475	Pest. MOA
11	90000798	M	36	00033904	5Q	61	00055953	Pest. MOA
12	90000854	2Q	37	00033965	5Q	62	90001485	Pest. MOA
13	90001020	Q	38	00033972	5Q	63	00011280	Pest. MOA
14	90001051	5Q	39	00037330	5Q	64	90000458	Pest. MOA
15	90001134	Q	40	00037376	5Q	65	00029983	Pest. MOA
16	90001137	Q	41	00039374	5Q	66	00043250	Pest. MOA
17	90001143	M	42	00041471	Q	67	00043253	Pest. MOA
18	90001145	2Q	43	00042984	Q	68	00043258	Pest. MOA
19	90001149	2Q	44	00043253	5Q	69	00047172	Pest. MOA
20	90001161	Q	45	80046811	2Q	70	00047175	Pest. MOA
21	90001254	5Q	46	80046812	2Q	71	00048659	Pest. MOA
22	90001343	2Q	47	80046813	2Q	72	00055310	Pest. MOA
23	90001344	2Q	48	00065002	Q	73	90002823	Pest. MOA
24	90001822	Q	49	00061858	Q	74	90000315	Pest. MOA
25	90001857	Q	50	00061854	Q			

Webpage Set Up for Groundwater Quality Monitoring Sites maintained by Kentucky Division of Water

Groundwater data uploads from the Kentucky Division of Water are added quarterly – wells, springs, and groundwater-quality data (including pesticide sampling from approximately 20 Division of Water/ Division of Pesticide MOA sites)

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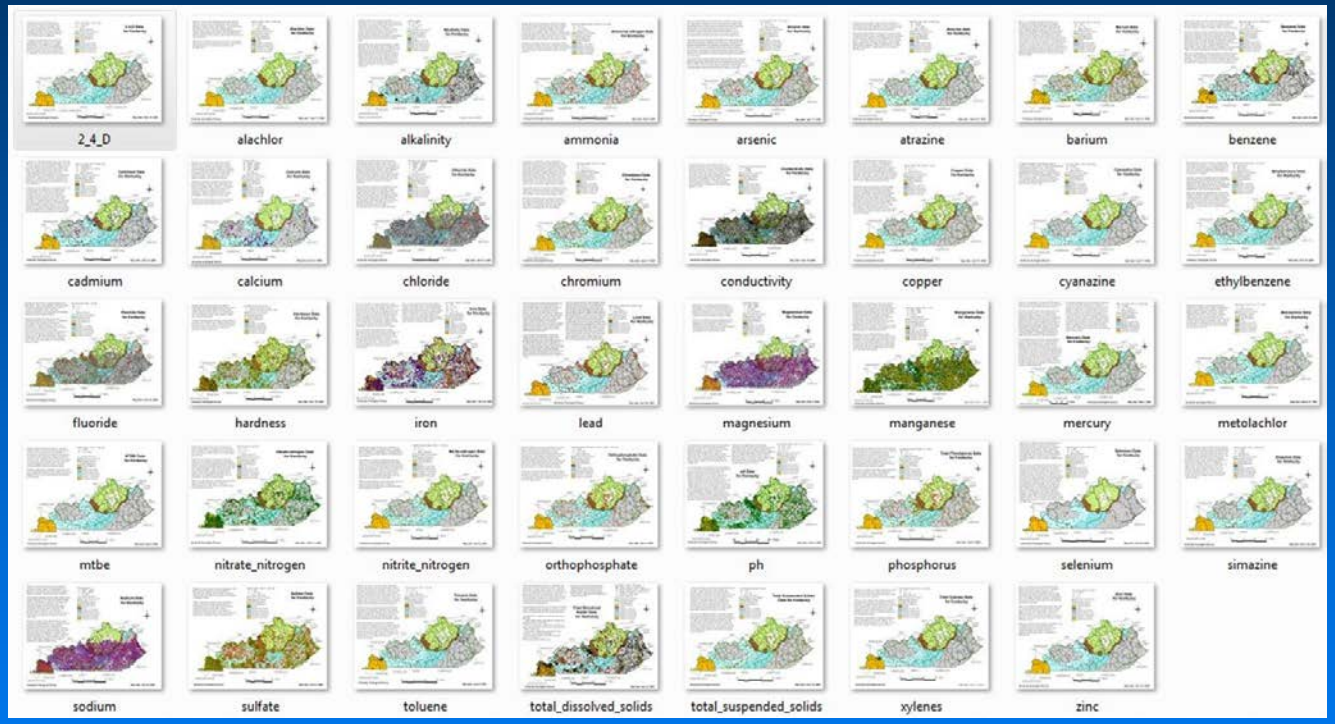
Updates to the Kentucky Groundwater Data Repository Relevant to Agriculture:

- Groundwater-quality range-of-value maps are being updated from 2008 to 2014:



- Includes data for:
  - Nutrients (ammonia, nitrate-nitrogen, nitrate-nitrogen, orthophosphate-phosphorus, and phosphorus)
  - herbicides (2,4-D)
  - pesticides (Alachlor, Atrazine, Cyanazine, Metolachlor, Simazine).

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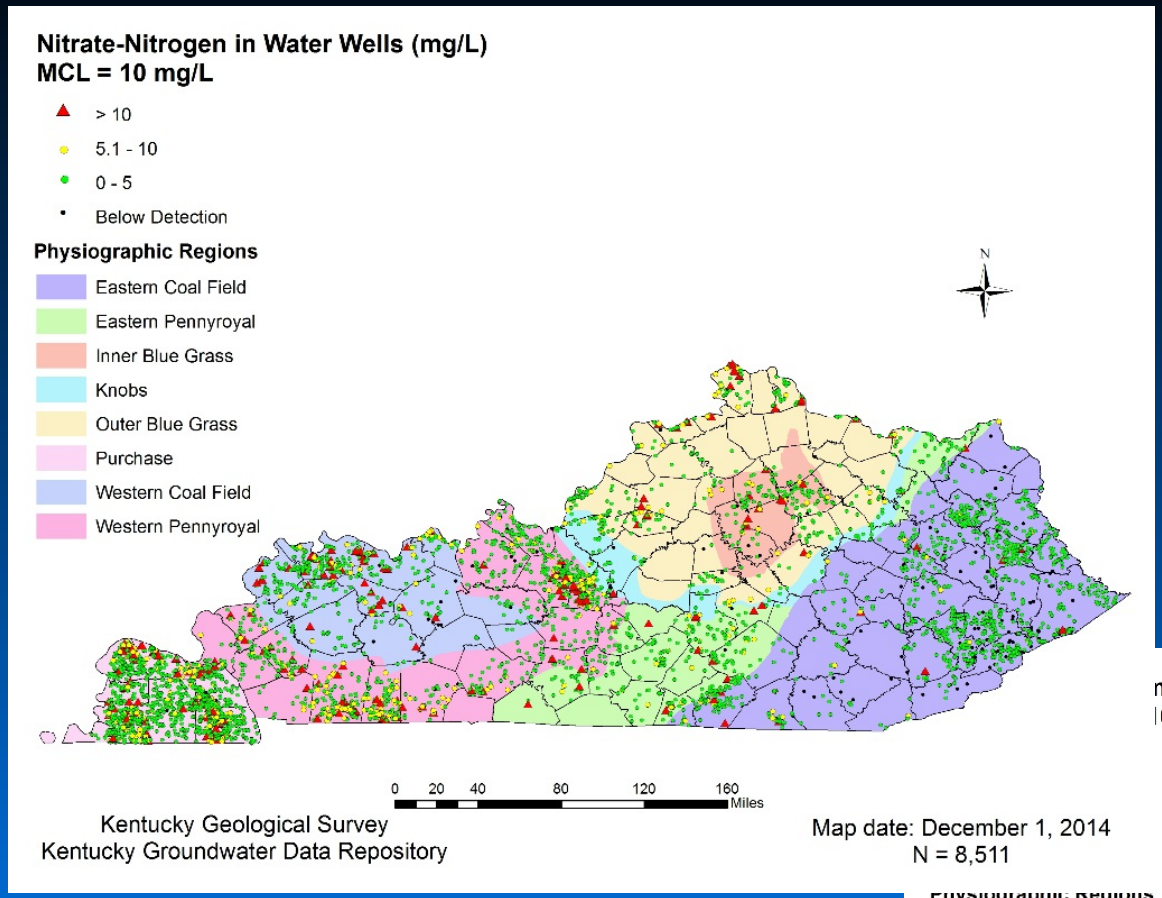
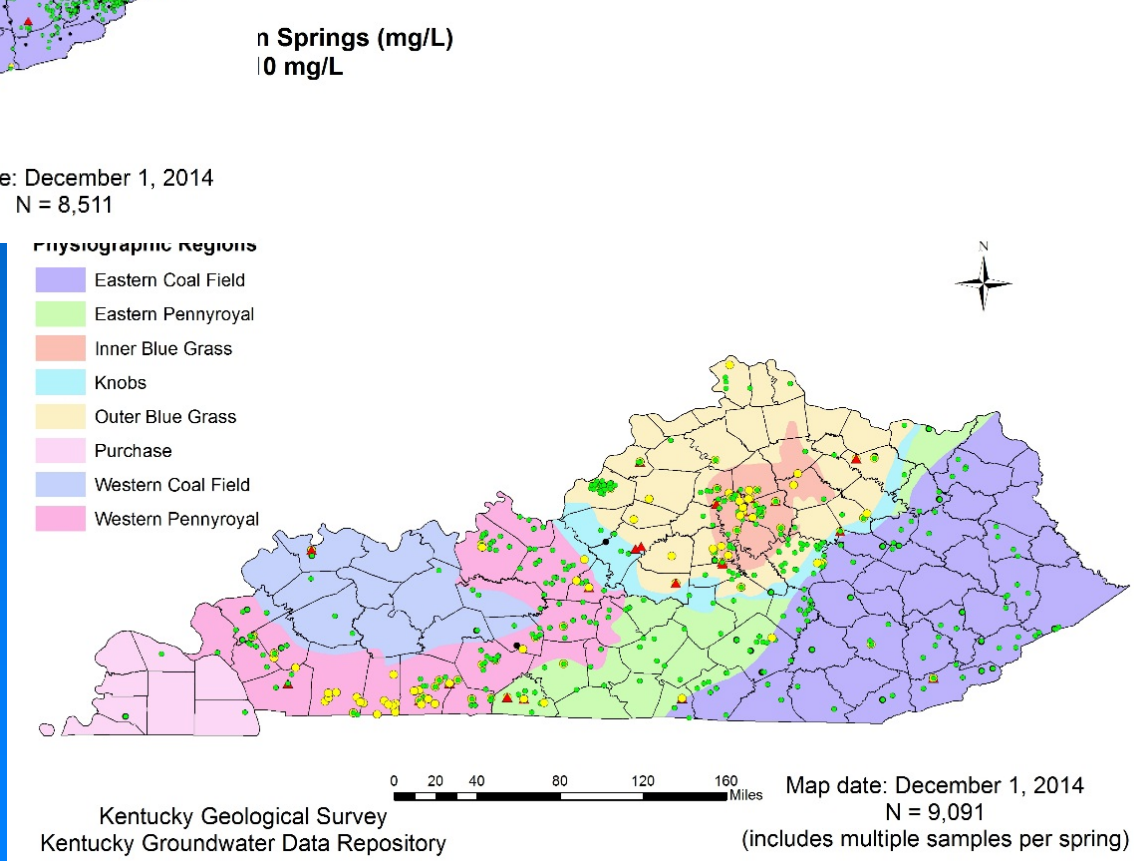
2014 Update for Nitrate-Nitrogen





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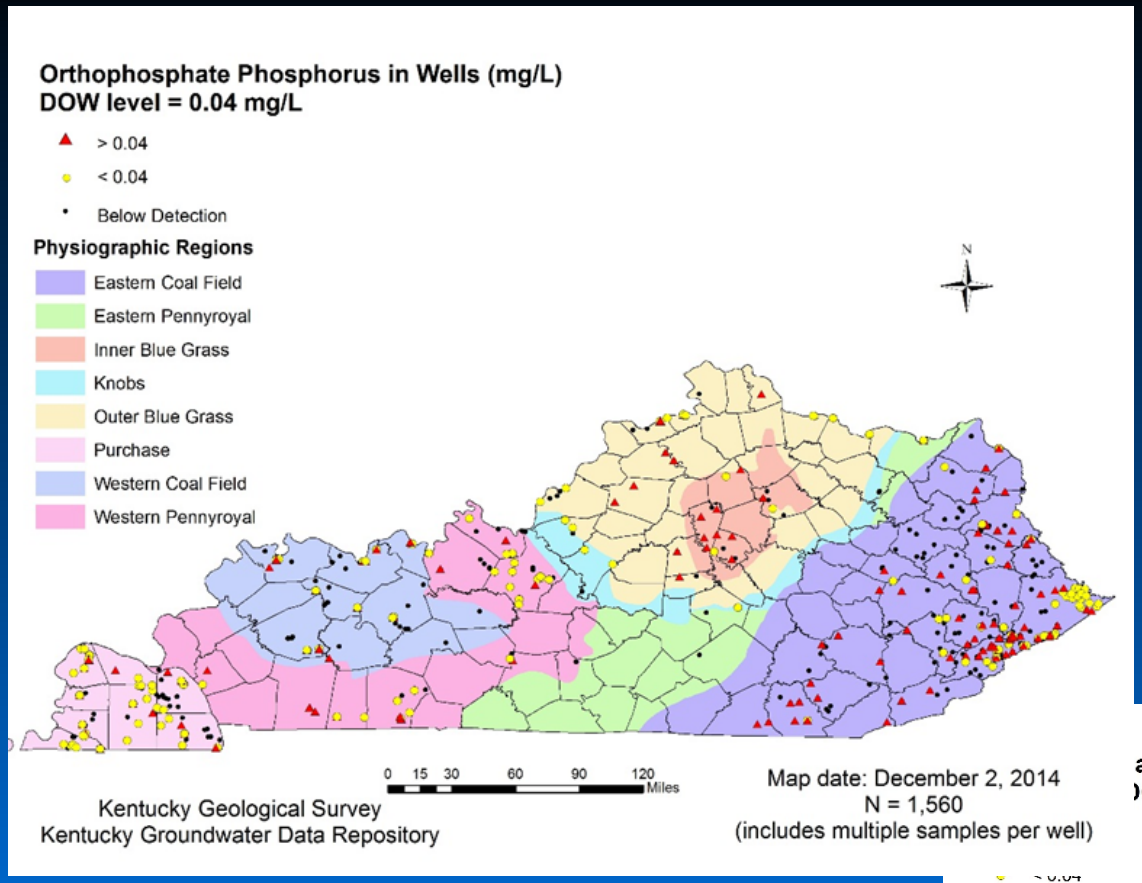
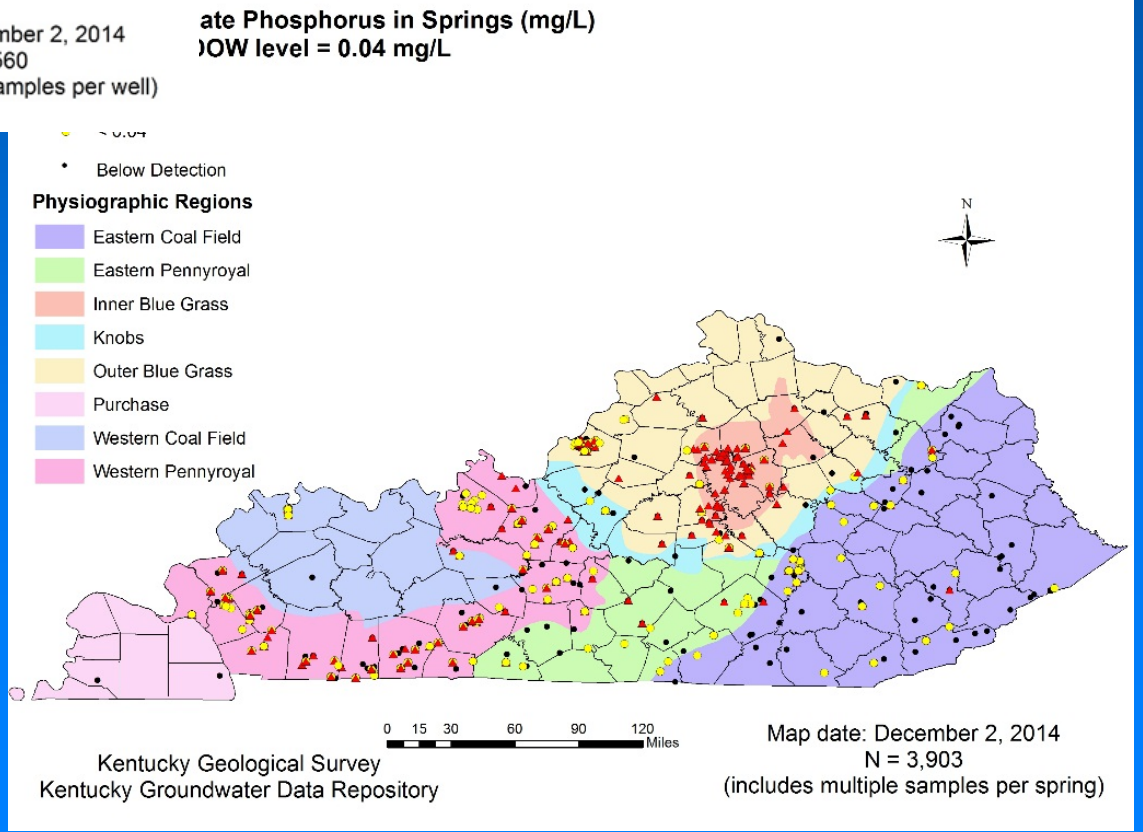
2014 Update for Orthophosphate-Phosphorus





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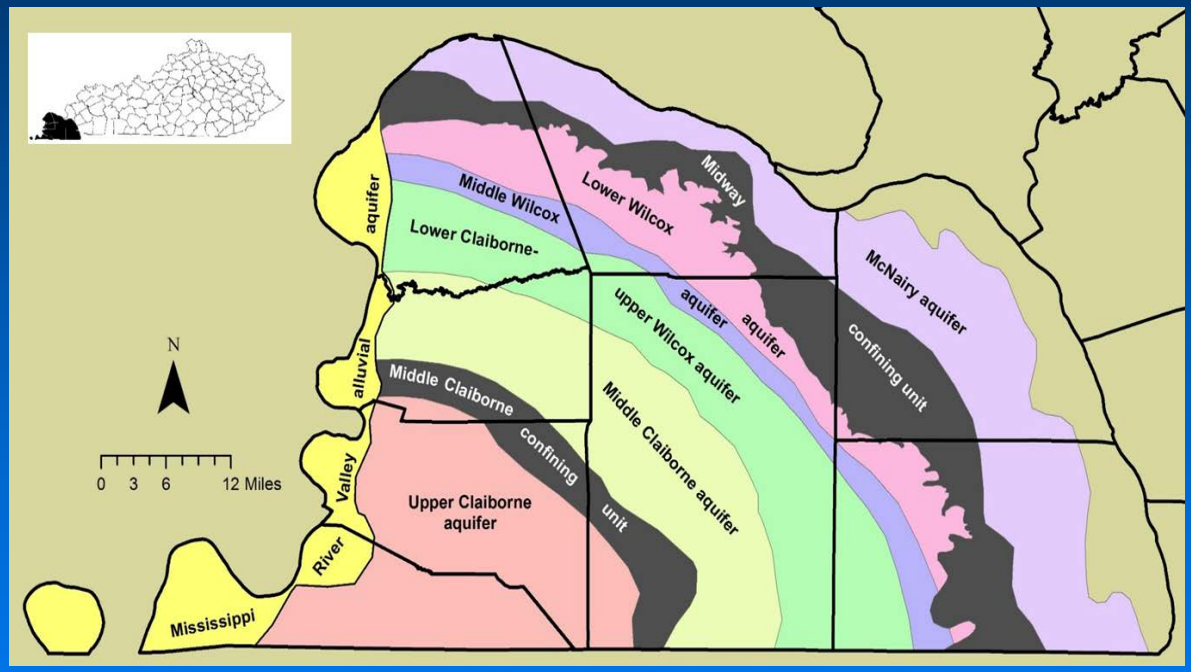
Current Things KGS Is Doing to Address:

- Improved Aquifer Boundaries and Water-Table or Potentiometric Surface Mapping.



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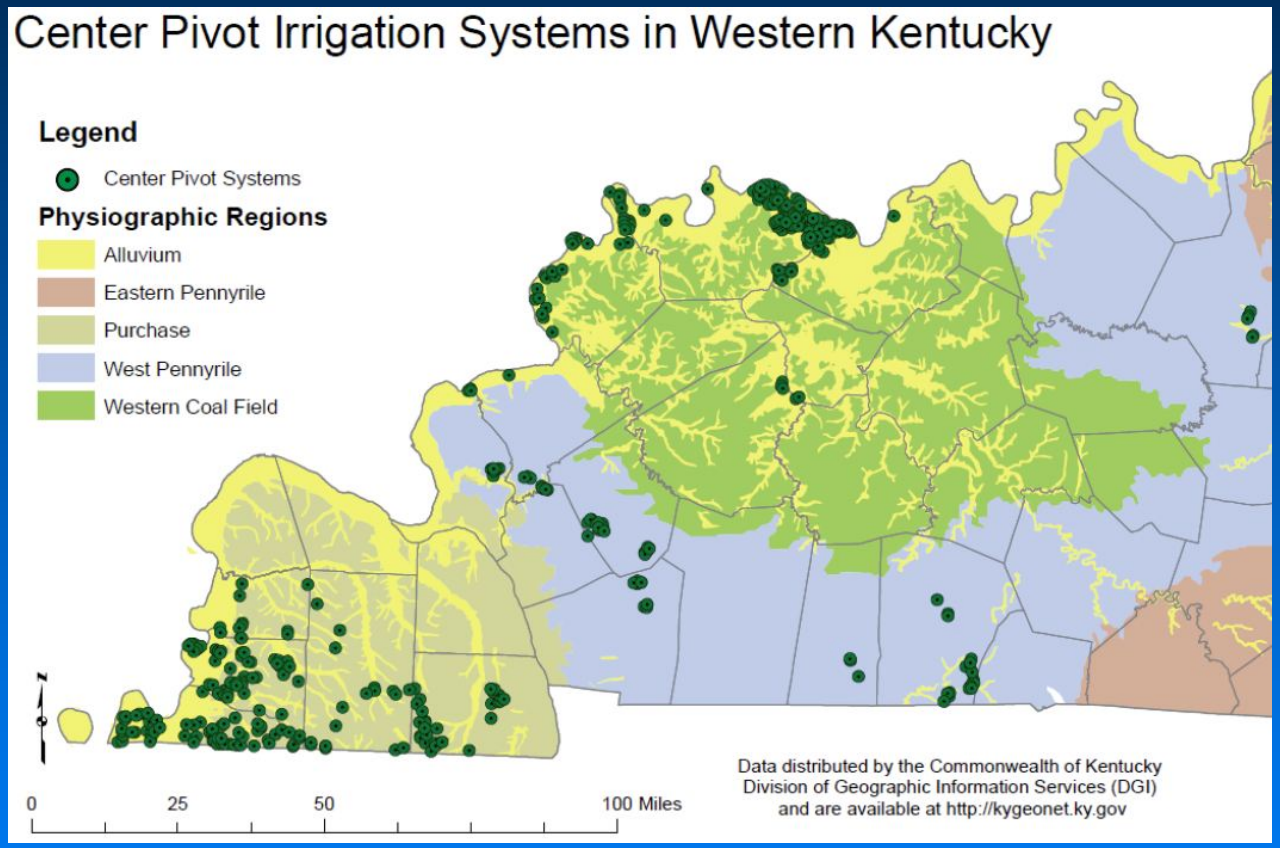
Aquifer Mapping for Assessment of Groundwater Availability and Sustainability for Agriculture in Western Kentucky



Courtesy of Jessica Moore, KDOW, 2014

- Numbers of irrigation wells are increasing every year.
- Can the aquifers provide sufficient water?
- Can well yields be sustained with increased anticipated demands?
- What are any possible long-term impacts?

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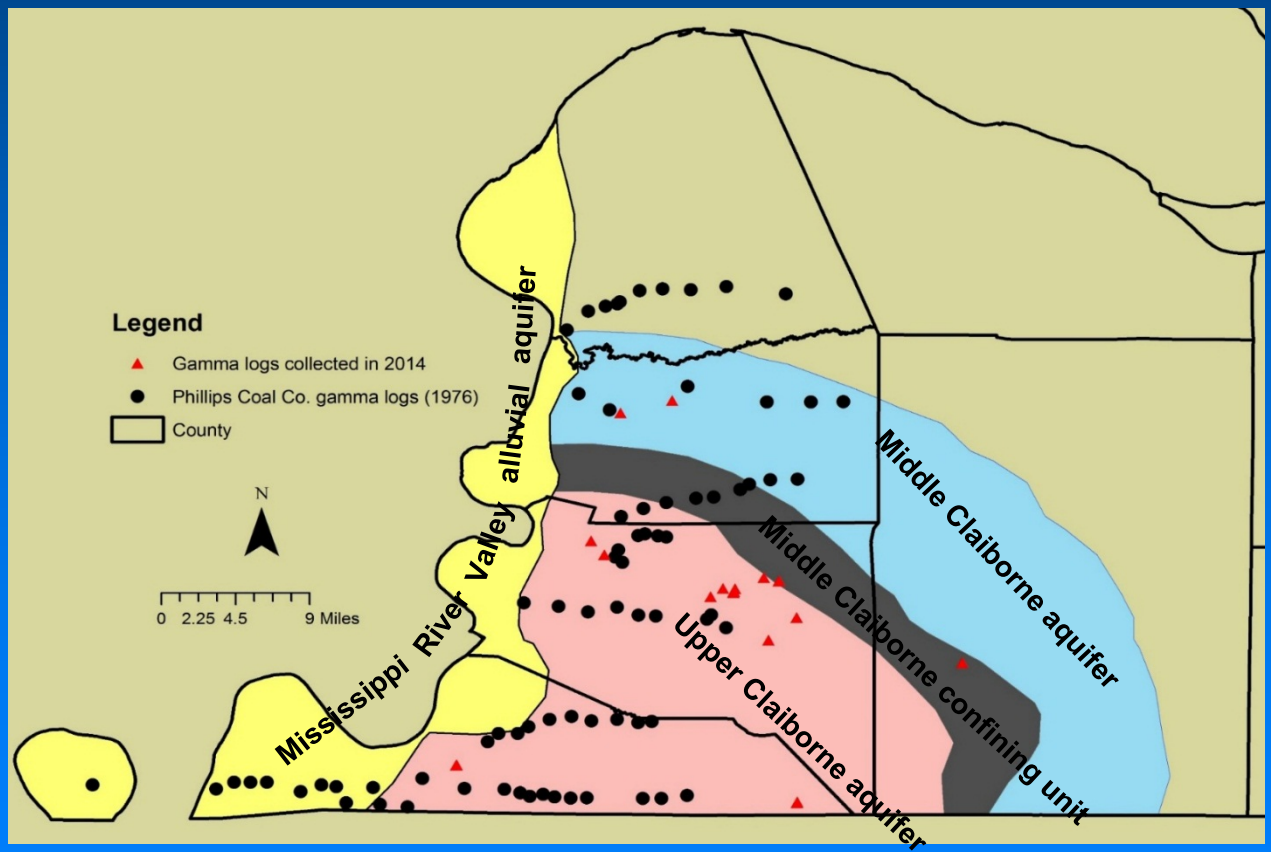
Present KGS Activity in western Jackson Purchase Area—

- Water well inventory and gamma-ray logging of selected irrigation and domestic wells.
- Digitizing scanned gamma-ray logs from Phillips Coal Company boreholes (ca. 1976).



Modified from Lloyd and Lyke, 1995

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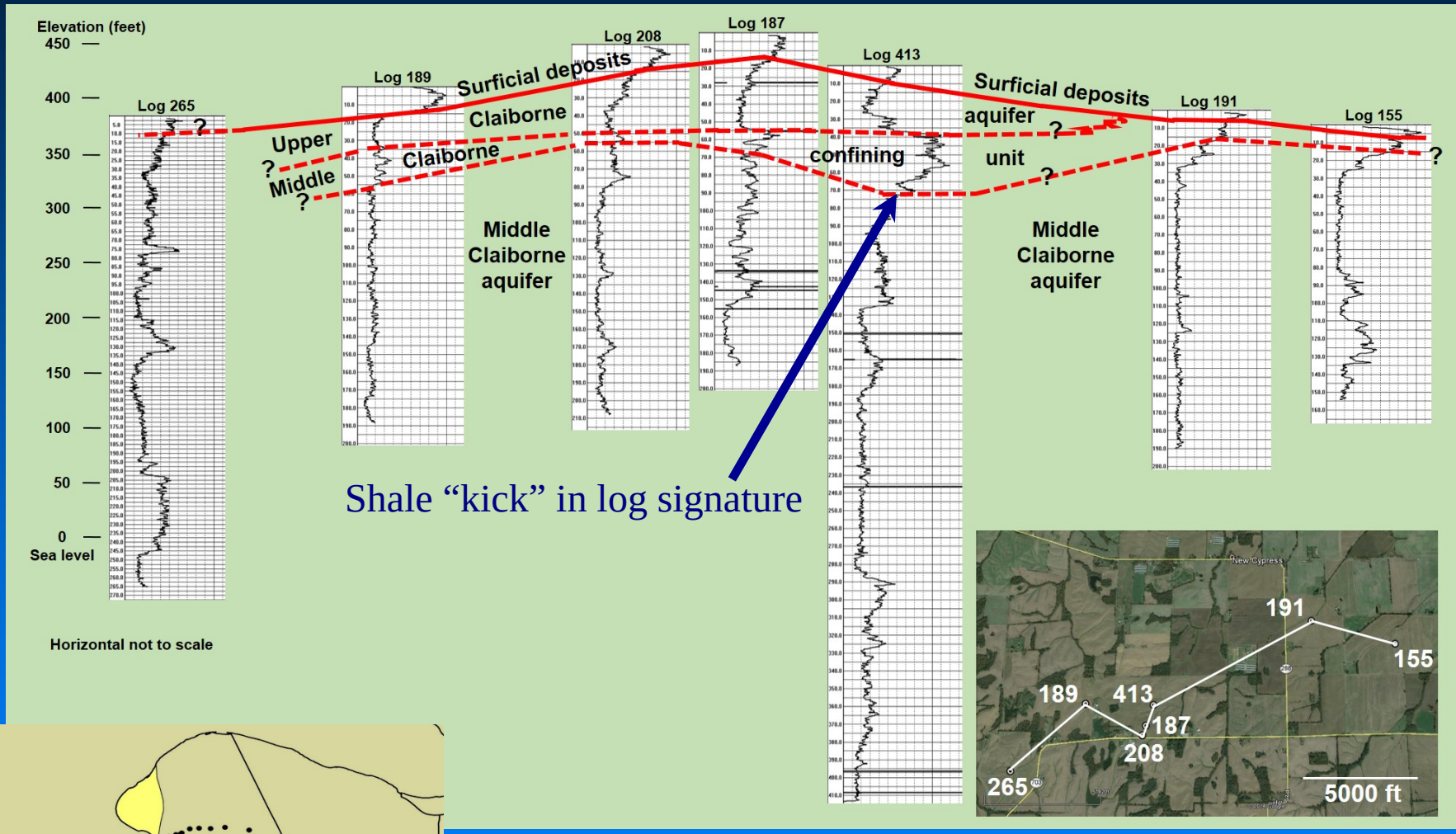
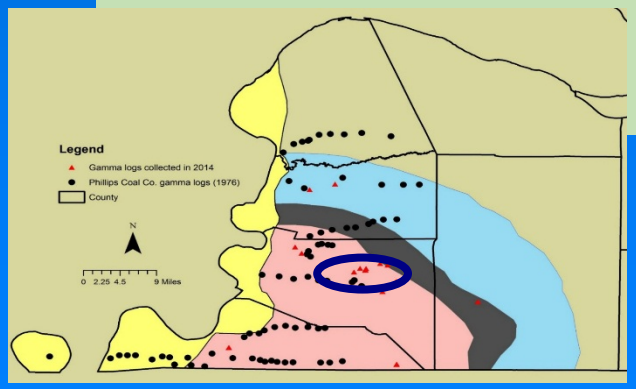
Gamma-Ray Logs of JPA Wells Raise Questions about Variations in Extent and Thickness of Aquifer Zones and Confining Units





These Questions May Have Important Implications for Groundwater Monitoring and Groundwater and Surface Water Resources Management in the Area.

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JPA Aquifer Mapping—Next Steps:

- Collect data to better determine the extent and thickness of the Middle Claiborne confining unit in the southwestern portion of the Jackson Purchase.
  - Collaborate with Dr. Ed Woolery and Marie Cooper (University of Kentucky Department of Earth and Environmental Sciences) and Dr. Junfeng Zhu (Kentucky Geological Survey) to use seismic reflection and electrical resistivity data to map the Middle Claiborne confining unit.
  - Create detailed hydrostratigraphic cross-sections.
- Identify water wells completed in the Upper Claiborne and Middle Claiborne aquifers and begin collection of synoptic water-level measurements.

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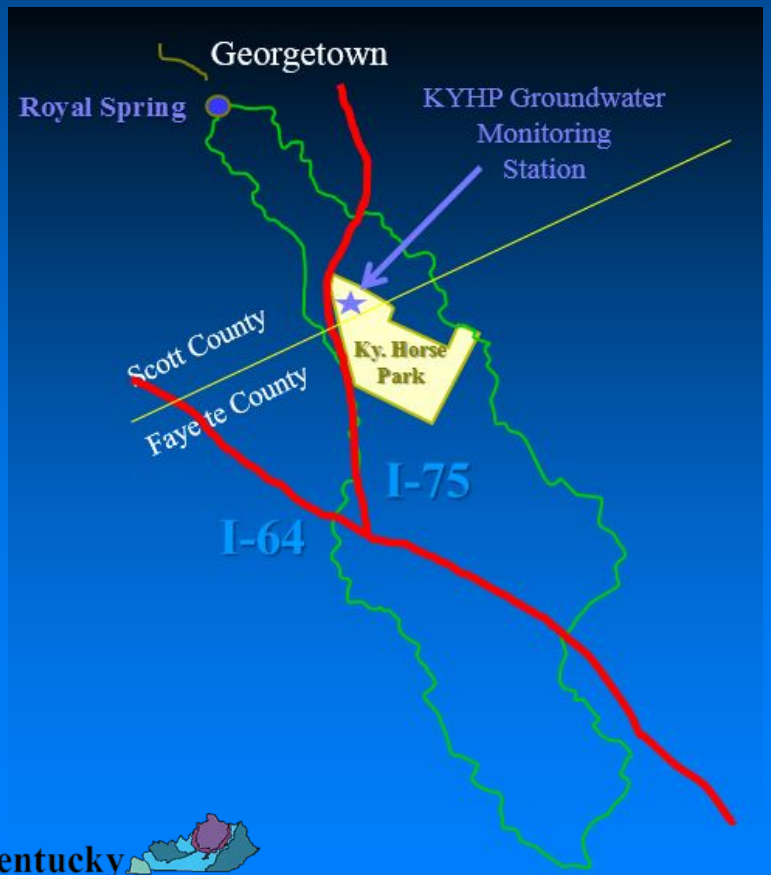
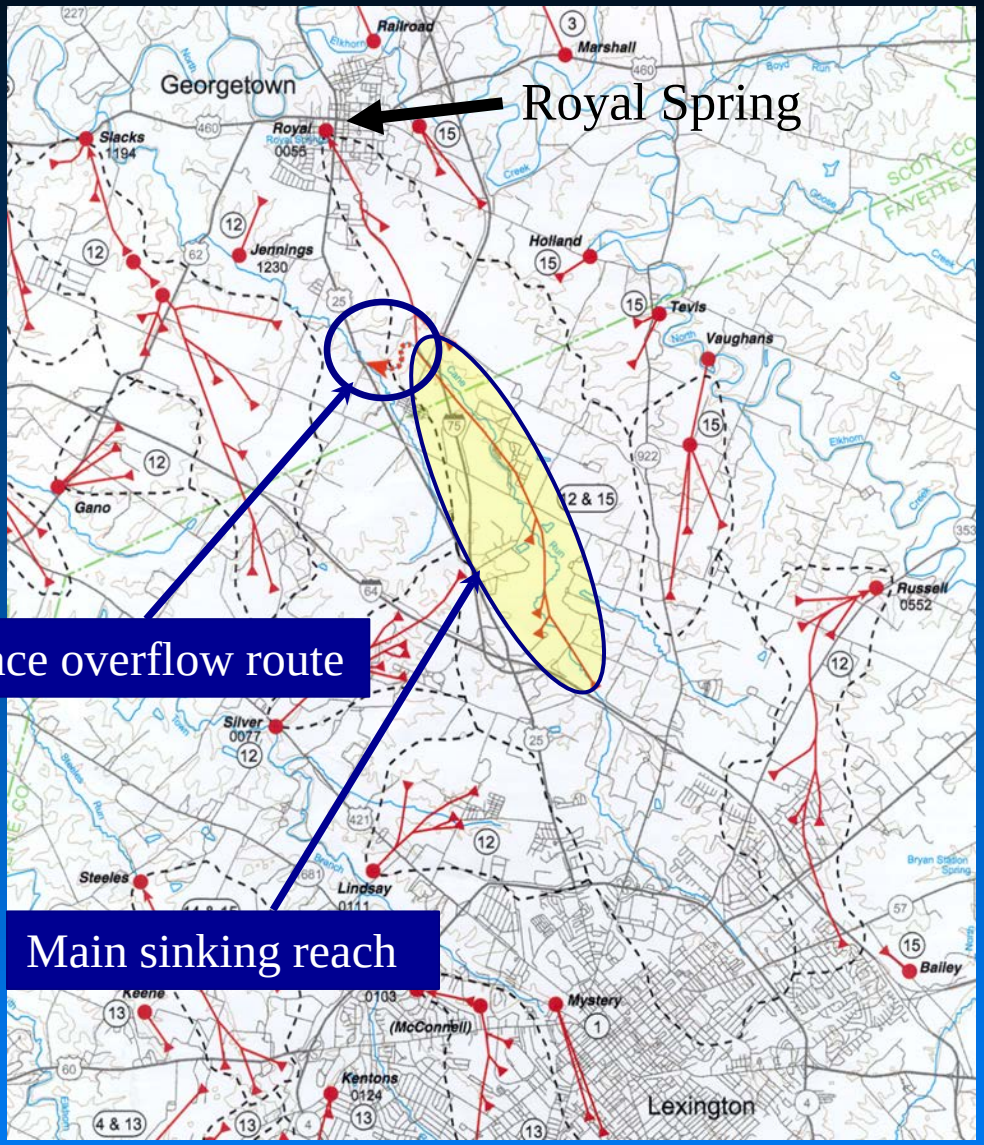
Current Things KGS Is Doing to Address:

- Special Studies to Better Characterize Groundwater Hydrology; Especially Factors that Influence Groundwater Quality and Quantity.

Determination of Mass Flux Discharge of Nutrients through Cane Run-Royal Spring Karst Basin.

Collaboration between KGS and UK Dept. Biosystems and Agricultural Engineering (BAE)





Lexington 30X60 minute Karst Basin Map

KGS objectives were to obtain discharge and concentration data and calculate nutrient fluxes for the subsurface karst groundwater system.

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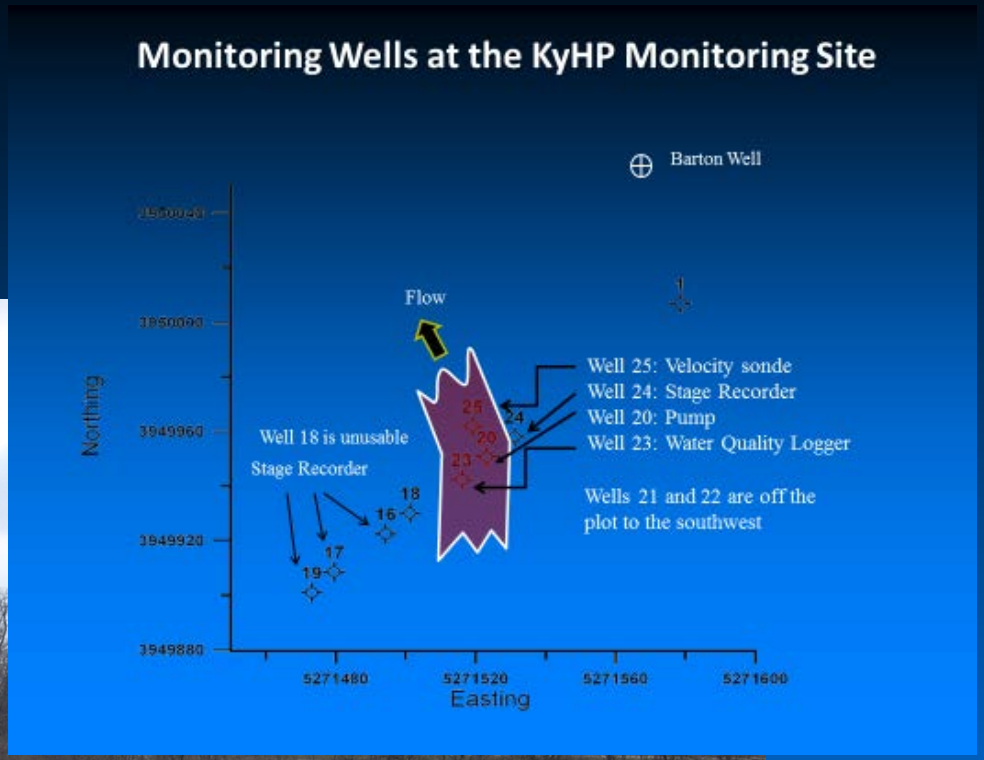
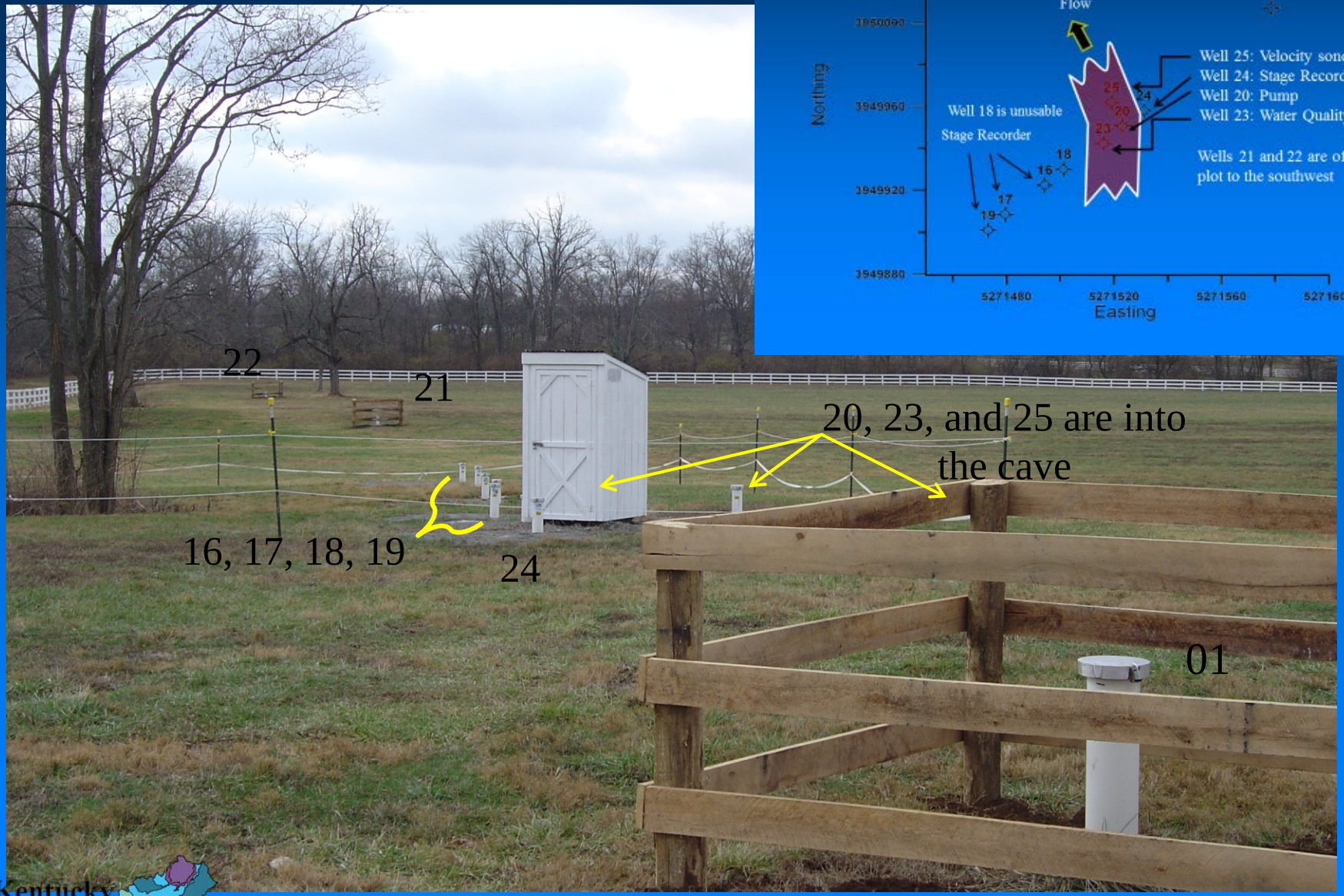
Monitoring Wells at KyHP Groundwater Station





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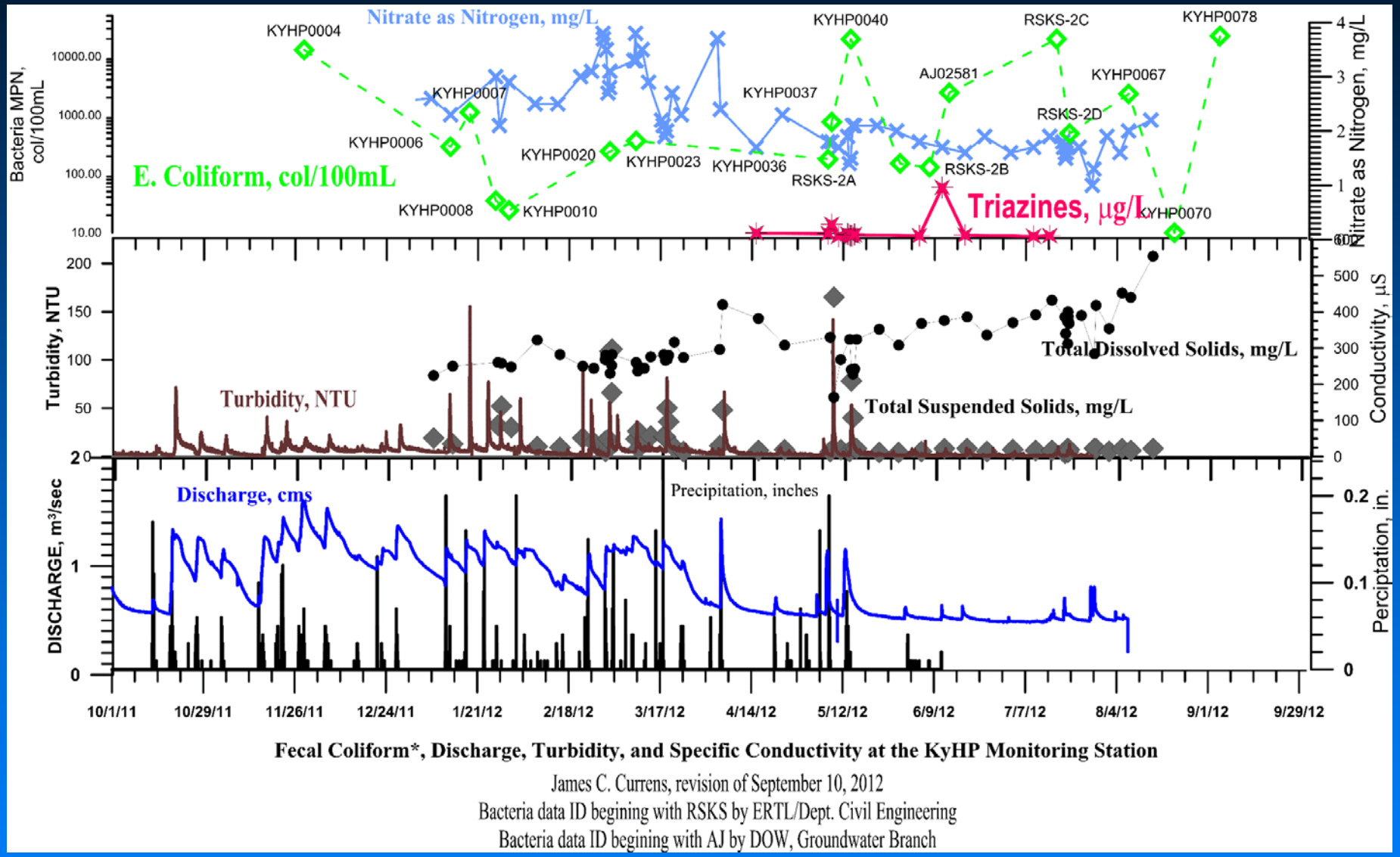
Example Dataset from KYHP Monitoring Station



Fecal Coliform*, Discharge, Turbidity, and Specific Conductivity at the KyHP Monitoring Station

James C. Currens, revision of September 10, 2012
Bacteria data ID begining with RSKS by ERTL/Dept. Civil Engineering
Bacteria data ID begining with AJ by DOW, Groundwater Branch

- Three years (2011-14) of collected data are under evaluation.
- Includes periodic and event-related data.

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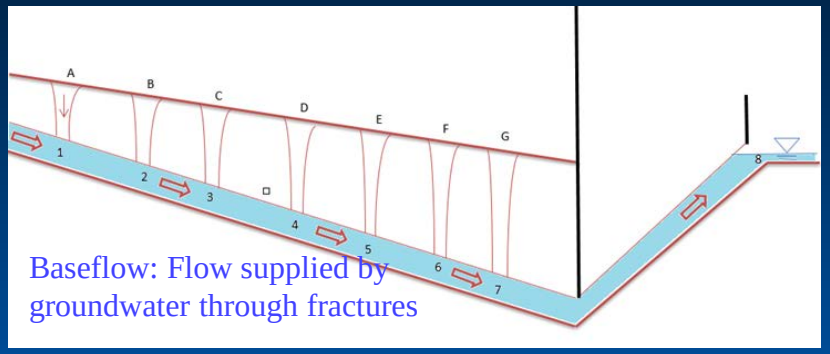
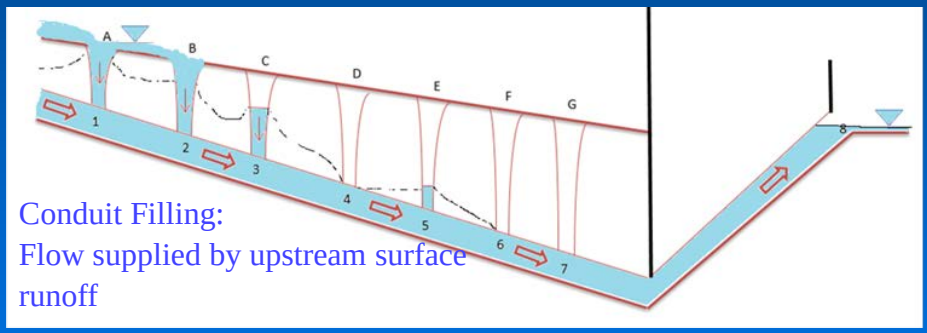
Follow-Up Work for Cane Run-Royal Spring basin

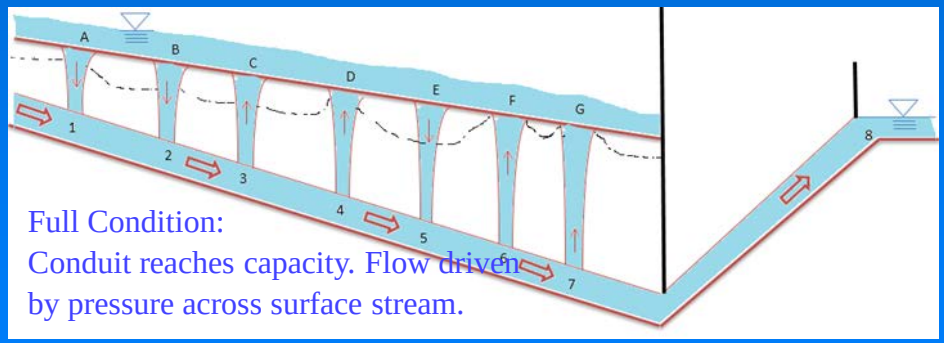
- Collaborative studies with other UK researchers to evaluate complex hydrologic mechanisms involved in nutrient transport and fate:
  - Ashley Bandy and Dr. Alan Fryar, UK Earth and Environmental Sciences
  - Admin Husic and Dr. James Fox, UK Civil Engineering
- Anticipated KGS studies focused on interrelation of various GWQ parameters (e.g. TSS and nutrients) and groundwater and surface water mixing in the Cane Run-Royal Spring basin.



Baseflow: Flow supplied by groundwater through fractures



Conduit Filling:
Flow supplied by upstream surface runoff



Full Condition:
Conduit reaches capacity. Flow driven by pressure across surface stream.

Illustrations of Hypothesized Cane Run-Royal Sp. Conduit Flow Dynamics—Courtesy of Admin Husic, UK Civil Engineering

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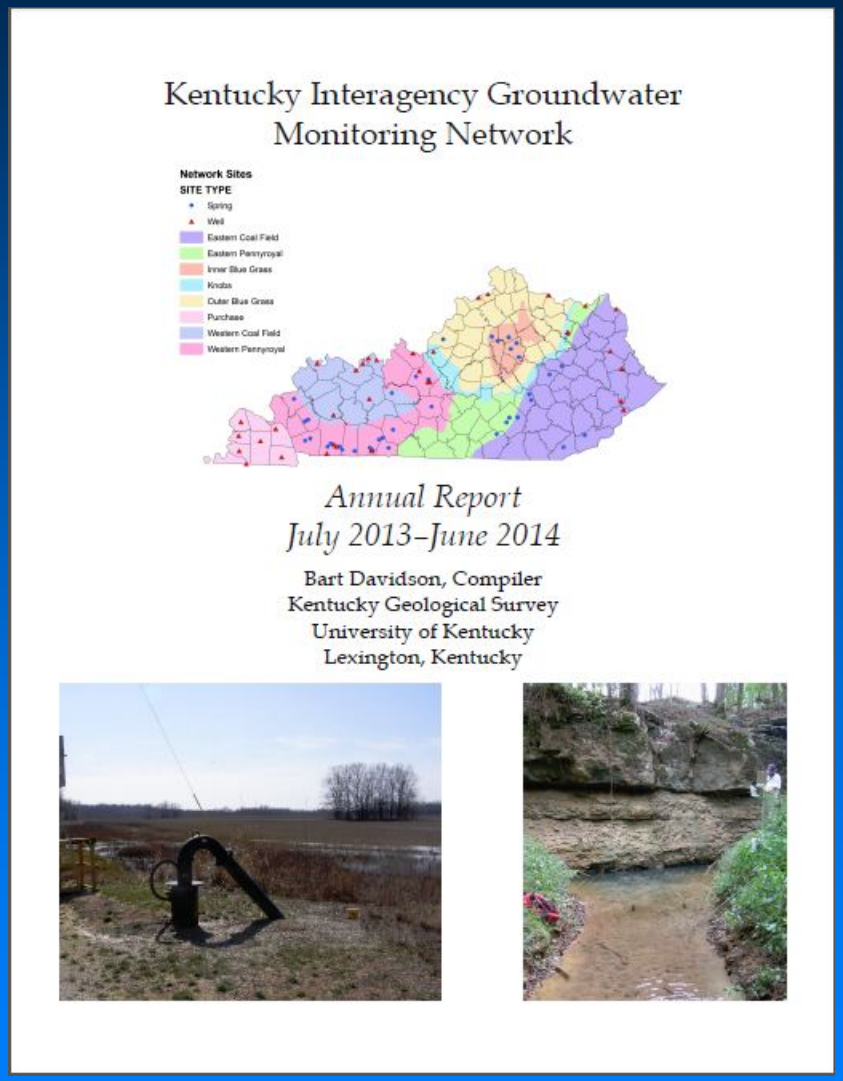
Other Groundwater Monitoring Activities and Studies:



http://www.uky.edu/KGS/

Click “Publications” → “Recent”

Summarizes groundwater investigations and data collection activities by ITAC members including:

- KDOW
- KGS
- USGS
- Other Collaborating State and Federal Agencies

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In Summary

- The KASMC 2014 draft work plan document summarizes several major issues related to groundwater and agriculture and makes several recommendations regarding needs related to
  - Expanded groundwater quality and quantity monitoring.
  - Aquifer mapping.
  - Improved access to data utilizing the KY GWDR.
  - Special studies that help to better understand groundwater quality and transport and fate of potential groundwater contaminants.

- KGS is currently working to
  - Re-establish an initial statewide groundwater observation network that fully supports the legislative mandates for groundwater data.
  - Advance aquifer mapping work in critical high-use areas of the state, starting with Jackson Purchase Area.
  - Collaborating with UK and other academic researchers to better understand groundwater hydrology and groundwater quality.

- Key part is building new strategic partnerships and taking advantages of unique new opportunities that present themselves, such as the Livestream project.

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